A Letter written to Dr. John Wallis *by Mr.* Henry Philips, *containing his Obſervations about the* True Time *of the Tides.*

WOrthy Sir, Being deſired by Mr. *O.* to give in, what informations I could, concerning the *Tides*, I have made bold to preſent this Paper to your Conſideration; which though it have little or no relation to your more curious Philoſophical Experiments, yet, I hope, will be of very good uſe for the finding out the *True time* of the *Tides* at all times of the *Moone*, which is (I conceive) of as great concernment, as any thing in the Motion of the Tides.

For, this *time* of the Tides, though it be a very neceſſary thing to be known, yet is very rudely and ſlightly reckoned up by moſt Seamen and Aſtronomers; moſt of them reckoning, as if the *Moone* being upon ſuch a ſet point of the *Compaſſe* (as the *Seaman* calls it) or ſo many houres paſt the *Meridian* (as the *Almanack-Makers* reckon) it were *High-Tide* in ſuch and ſuch a Port at all times of the Moone. And thus they reckon the Tides every day to differ conſtantly 48 *m.* As for inſtance; A *South-Weſt* Moone makes a full Tide at *London*, that muſt be underſtood, that it is *High-Tide* at *London* when the Moon is three hours paſt the *Meridian*. Now this is true indeed at the *New* and *Full* Moon, but not at other times of the Moone, which few take any notice of: only Mr. *Booker* had wont to give this *Caveat*, that about the *firſt* and *laſt* quarters of the Moone, the *Neap-tides* did not flow ſo long as the *Spring-tides* by *one* point of the *Compaſſe*; but he gives no rule to proportion the difference.

But obſerving this more narrowly, I find, that at *London* the Tides fall out at the leaſt *two* points, that is, one hour and an half ſooner, in the *Quarters* then in the New and Full Moone. Now this being a very conſiderable difference of time, which might very well make many Seamen and Paſſengers to loſe their Tides, I ſet my ſelf to watch this difference of the time of the Tides, and to find out ſome *Rule*, how to proportion the time of the Tides between the *Spring-tides* and the *Neap-tides*, and I found by many trialls, that the *true time* of the *Tides* might be found

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out to be ſomewhat ſhorter and ſhorter, from the *New* and *Full* Moone unto the *Quarters*; yet not in an *equall* manner, neither *gradually* decreaſing from the *New* and *Full* Moone untill the *Quarters*; but rather, that there was ſome little difference of alteration both at the *New* and *Full* Moones, and alſo at the *Quarters*; and that the greateſt difference fell out in the midſt between them, agreeing very well to a *Circular* proportion, after this manner: (See Fig. 5.)

Firſt, Divide a *Circle* into 12 Equal parts, or hours, according to the Moones motion or diſtance from the Sun, from the *New* Moone to the *Full*.

Secondly, Let the *Diameter* of the Circle be divided into 90 parts or min. that is, according to the time of the difference of Tides between the *New* or *Full* Moone, and the *Quarters*; which is one hour and an halfe.

Thirdly, Make *perpendicular* lines croſs the *Diameter* of the Circle, from hour to hour.

Fourthly, Reckon the time of the Moones coming to the *South* in the circumference of the Circle, and obſerve the *Perpendicular-Line*, that falls from that point upon the Diameter; and the proportionall *Minutes*, cut thereby, will ſhew, how many *Houres*, or *Minutes* are to be ſubſtracted from the time of High-tides at the *New* and *Full* Moone, that ſo you may have the true time of the *Tides* that preſent day.

For *Example*; At *London*, on the day of *New* and *Full* Moone, it is High-Tide at *London* at 3 of the Clock, that is, when the Moone is three hours paſt the *Meridian*: and ſo by the Common Rule, the *Moone* being about four dayes old, it will be South about three of the Clock, and it will be High-tide three houres afterwards, that is, at 6 of the Clock. But now by this Rule, if you count this time of the *Moones* coming to the South in the Circumference, the perpendicular-line, which comes from 3 to 9, cuts the *Diameter* in the halfe, at 45 min. which ſhews, that ſo much is to be abated from the time of High-tide in the *New* and *Full Moones*; So that it is High-tide 45 min. before 6 of the Clocke, that is, at 5. hours 15 min. and not at 6 of the clock, according to the *common-Rule*.

The like you may do for any other Port or place, knowing the time

time of High-water at the *New* and *Full* Moon in that place: And you may do it the more readily, if you ſet down the time of High-water at the *New* and *Full* Moon under the *Diameter*, as I have done for *London*, where it is high-tide at III. of the clock. So that when the Moon is South at III. of the clock, the perpendicular cuts the *diameter* at II. hours 15. m. which added to the time of the *South*-ing makes it V. hours 15. m. and ſo when the Moon is *South* at IX. of the clock, by adding 2 h. 15 m. you have the time of high-water, which is XI. of the clock and 15 m.

And thus you may eaſily make a *Table*, which by the *South*ing of the Moon, ſhall readily tell you the time of High-tide at any time of the Moon, as I have done here for *London*: To which all other places may be reduced to correſpond.

Moon South	Tide *London*	Moon South	Tide *London*	Moon South	Tide *London*	Moon South	Tide *London*
H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
XII 0	3 0	III 0	5 15	VI 0	7 30	IX 0	11 15
10	3 9	10	5 21	10	7 41	10	11 29
20	3 18	20	5 27	20	7 52	20	11 43
30	3 27	30	5 33	30	8 4	30	11 57
40	3 36	40	5 40	40	8 14	40	12 10
50	3 45	50	5 46	50	8 25	50	12 24
I 0	3 54	IV 0	5 52	VII 0	8 36	X 0	12 37
10	4 2	10	5 59	10	8 48	10	12 50
20	4 9	20	6 6	20	9 0	20	1 3
30	4 16	30	6 13	30	9 13	30	1 16
40	4 23	40	6 20	40	9 26	40	1 29
50	4 30	50	6 28	50	9 39	50	1 42
II 0	4 37	V 0	6 36	VIII 0	9 53	XI 0	1 54
10	4 44	10	6 44	10	10 6	10	2 3
20	4 50	20	6 53	20	10 20	20	2 16
30	4 57	30	7 2	30	10 33	30	2 27
40	5 3	40	7 11	40	10 47	40	2 38
50	5 9	50	7 20	50	11 1	50	2 49

A Table of the time of High Tide for this preſent year *Anno* 1668. *London*-Bridge: where *M.* denotes *Morning*, and *P. Afternoon.*

	Jan.		Febr.		Mar.		April		May		June		July		Aug.		Sept.		Octo.		Nov.		Dec.	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	12		2 P	13	1 P	49	2 P	6	3 P	23	4	18	4	30	5 P	5	5	54	6	36	8	18	8	36
2	1 P	2	3	11	2	45	3	57	4	44	5	51	4	59	5	32	6	37	7	27	9	20	9	33
3	2	3	3	56	3	29	4	22	4	39	5	20	5	25	6	2	7	23	8	32	10	24	10	32
4	3	37	4	30	4	8	4	35	5	11	5	48	5	52	6	39	8	28	9	43	11	30	11	36
5	4		5	1	4	40	5	24	5	40	6	18	6	23	7	25	9	41	10	54	12	31	12	4
6	4	57	5	29	5	9	5	55	6	12	6	54	7	1	8	28	11	2	12	3	M	31	M	40
7	5	26	5	58	5	38	6	30	6	49	7	37	7	47	9	43	12	24	M	3	1	32	1	43
8	5	55	6	30	6	9	7	13	7	32	8	27	8	46	11	7	M	24	1	10	2	27	2	37
9	6	2	7	11	6	49	8	5	8	21	9	27	9	57	12	30	1	35	2	9	3	18	3	28
10	7	5	7	59	7	32	8	58	9	18	10	39	11	19	M	30	2	34	3	1	4	2	4	10
11	7	47	8	53	8	28	9	58	10	19	11	53	12	46	1	48	3	24	4	45	4	37	4	41
12	8	31	9	58	9	28	11	2	11	26	1	16	M	46	2	53	4	6	4	23	5	8	5	10
13	9	33	1	7	10	33	12	6	12	34	1 M	16	2	6	3	45	4	39	4	57	5	37	5	37
14	10	19	12	16	11	40	M	6	M.	34	2	27	3	15	4	24	5	11	5	27	6	6	6	4
15	11	47	M	16	12	44	1	10	1	44	3	33	4	4	4	56	5	41	5	59	6	42	6	35
16	12	54	1	18	M	44	2	13	2	56	4	22	4	41	5	25	6	14	3	34	7	21	7	12
17	M	54	2	18	1	44	3	9	3	49	5	1	5	5	5	54	6	54	7	16	8	5	7	58
18	1	56	3	8	2	37	4	3	4	36	5	24	5	43	6	29	7	4	8	6	8	56	8	49
19	2	50	3	49	3	27	4	45	5	1	6	8	6	15	7	11	8	34	8	57	9	54	9	55
20	3	36	4	24	4	13	5	23	5	53	6	44	6	53	8	4	9	35	9	54	10	58	11	9
21	4	13	4	57	4	50	6	3	6	33	7	25	7	35	9	0	10	40	10	55	12	9	12	30
22	4	44	5	30	5	26	6	48	7	17	8	16	8	28	10	4	11	43	11	58	1 P	19	1 P	52
23	5	13	6	5	6	4	7	42	8	8	9	7	9	27	11	1	12	44	12	59	2	26	3	2
24	5	41	6	48	6	51	8	38	9	0	10	10	10	33	12	16	1 P	42	2 P	1	3	27	3	58
25	6	13	7	46	7	48	9	35	9	58	11	12	11	32	1 P	16	2	34	2	58	4	17	4	41
26	6	5	8	53	8	53	10	44	10	58	12	18	12	48	2	12	3	32	3	48	4	59	5	15
27	7	49	10	10	10	2	11	47	12	1	1 P	21	1 P	49	3	14	4	4	4	32	5	36	5	47
28	8	55	11	28	11	12	12	49	1 P	2	2	19	2	43	3	43	4	41	5	11	6	14	6	19
29	10	16	12	43	12	20	1	47	2	2	3	11	3	27	4	18	5	18	5	49	6	55	7	0
30	11	44			1 P	21	2	28	2	55	3	54	4	16	4	30	5	52	6	31	7	43	7	45
31	1 P	2			2	16			3	40			4	37	5	21			7	21			8	36

Theſe things I have found to fall out right at *London* for many years, and ſo I ſuppoſe they may in other places. If the difference be not ſo much between the Neap-tides and Spring-tides in other places, the Diameter muſt be divided into fewer parts.

As for the higeſt Tides to happen two or three dayes after the full Moon, I have not made much obſervation of it, and ſee little reaſon for it, but the time thereof agrees here with. And high Spring-tides are not alwayes alike; this year I have not obſerved any. I ſhould be glad to hear, how theſe rules hold in other places, that ſo this *true time* of the Tides may be more punctually known.

April 6. 1668. *An*